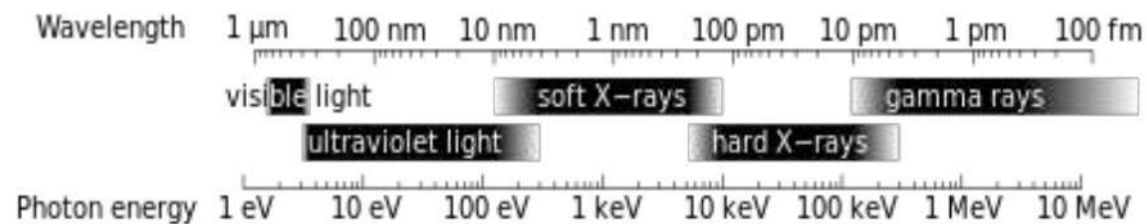


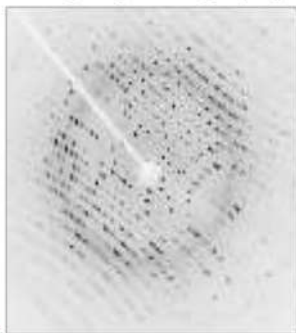
X-Ray Physics and Radiographic Positioning

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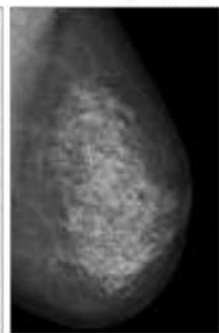
- ▶ X-rays are for of **electromagnetic waves**, they are more energetic so they can penetrate many materials to varying degrees.
- ▶ When the X-rays hit the film, they expose it just as light would. Since bone, fat, muscle, tumors and other masses all absorb X-rays at different levels, the image on the film lets you see different (distinct) structures inside the body because of the different levels of exposure on the film.
- ▶ X-rays have a wavelength in the range of 0.01 to 10 nanometers, corresponding to frequencies in the range 30 petahertz to 30 exahertz (3×10^{16} Hz to 3×10^{19} Hz) and energies in the range 100 eV to 100 keV.
- ▶ The wavelengths are shorter than those of UV rays and longer than those of gamma rays



X-ray crystallography



Mammography




Medical CT




Airport security



Origin:

- ▶ **X-ray technology** was invented completely by accident. In 1895, a German physicist “Wilhelm Roentgen” made the discovery while experimenting with **electron beams** in a **gas discharge tube**.
 - ▶ Roentgen noticed that a fluorescent screen in his lab started to glow when the electron beam was turned on. This response in itself wasn't so surprising -- fluorescent material normally glows in reaction to electromagnetic radiation -- but Roentgen's tube was surrounded by heavy black cardboard. Roentgen assumed this would have blocked most of the radiation.
 - ▶ Roentgen placed various objects between the tube and the screen, and the screen still glowed. Finally, he put his hand in front of the tube, and saw the outline of his bones projected onto the fluorescent screen. Immediately after discovering X-rays themselves, he had discovered their most beneficial application.
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Working

- ▶ X-rays were found to be able to penetrate through materials of light atoms like flesh. The heavier atoms like metal absorb them.
 - ▶ A beam of high energy electrons crashes into a metal target and x-rays are produced. A filter near the x-ray source blocks the low energy rays so only the high energy rays pass through a patient toward a sheet of film.
 - ▶ Along with the sheet of film, a second sheet of film prevents the scattered x-rays from fogging the picture.
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Cont..

- ▶ Calcium in bones is considered a type of metal and when photographic film is placed on the body, this allows the technician to take the picture and an x-ray is developed to solve or analyze the problem.
- ▶ The soft tissue in your body is composed of smaller atoms, and so does not absorb X-ray photons particularly well. The calcium atoms that make up your bones are much larger, so they are better at **absorbing X-ray photons**.



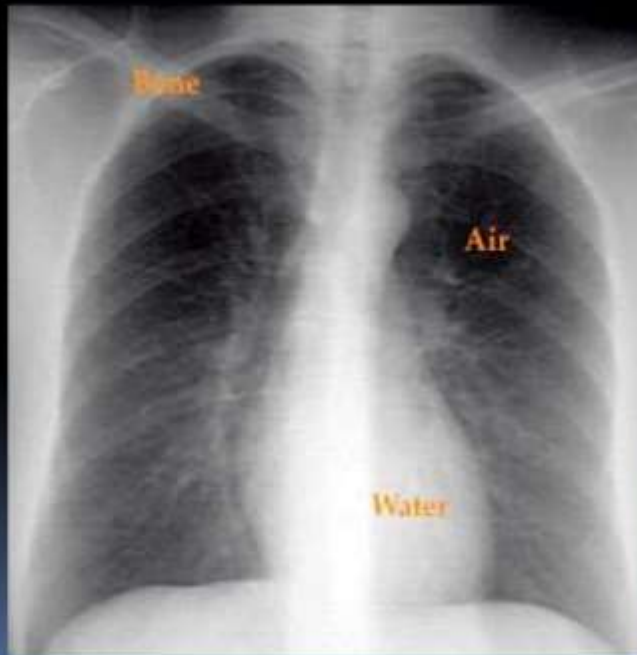
POSITIONING TERMINOLOGY

- Radiographic positioning refers to the study of patient positioning performed for radiographic demonstration or visualization of specific body parts on image receptors.
- Each person who plans to work as a radiologic technologist must clearly understand the correct use of positioning terminology.

Chest Xray

||| Different tissues in body absorb X-rays at different extents:

- Bone- high absorption (white)
- Tissue- somewhere in the middle absorption (grey)
- Air- low absorption (black)



CXR - PA Vs AP view.

PA- the x-rays penetrate through the back of the patient on to the film

AP-the x-rays penetrate through the front of the patient on to the film.

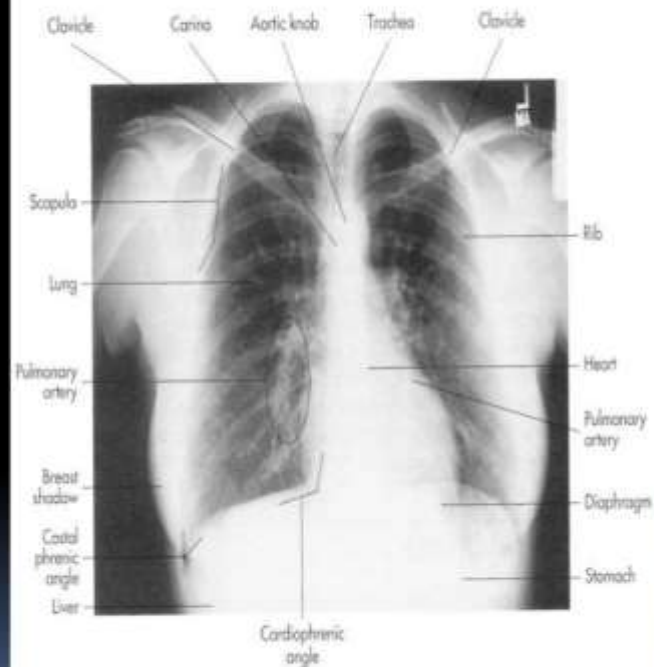
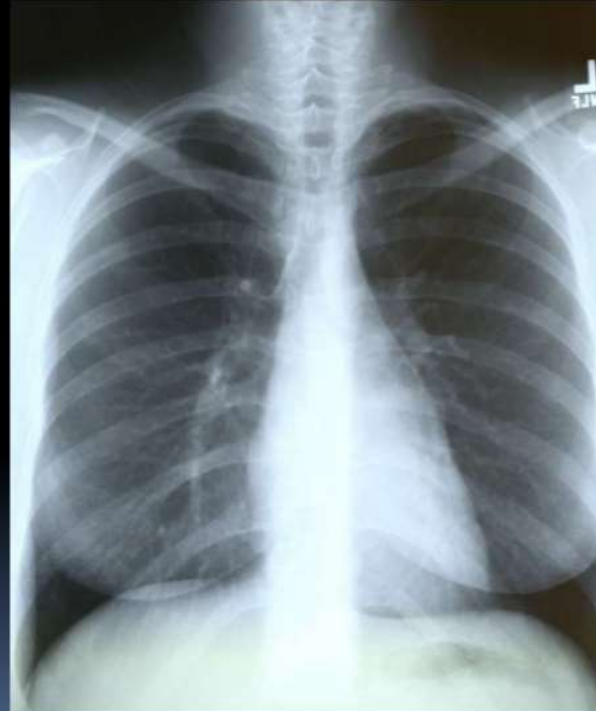


Fig. 3-1 Normal position of anatomical structures on a posterior or anterior chest radiograph.

Penetration / Exposure

- ▣ Able to see ribs through the heart
- ▣ Barely see the spine through the heart
- ▣ Pulmonary vessels can be traced nearly to the edges of the lungs



Underpenetrated Film

Hemi diaphragms are obscured

Pulmonary markings more prominent than they actually



Over penetrated Film

- Lung fields darker than normal—may obscure subtle pathologies
- See spine well beyond the diaphragms
- Inadequate lung detail



Positioning / Rotation

Does the thoracic spine align in the center of the sternum and between the clavicles?

Clavicles – equidistant from spine

Determine side – ? L/R

- Gastric bubble should be on the left (normally)

Look at

- Soft tissue
- Bony cage

Soft tissue and bony structures

- Check for
 - Symmetry
 - Deformities
 - Fractures
 - Masses
 - Calcifications
 - Lytic lesions

Cervical Spine-Anteroposterior

Patient Preperation

- Ask the patient to remove the all metals plastic retainer & earring also.

Position

- Make the patient to lie on the x-ray table.
- Mid saggital plane should be center to the center of the table.
- The patient should face towards the tube.
- The chin is raised, so that the mandible is superimposed on the occipital.(The line from the tip of the mandible to the base of the skull should be parallel to the center.)
- Ensure there is no rotation of the head.
- Radiation Production given to the patient.

Tube Centering

- Center to the mid line joint of the angle of mandible or at the level of C3-C4.
- Tube angulation is 5° to 15° Cephalad.

Cassette centering

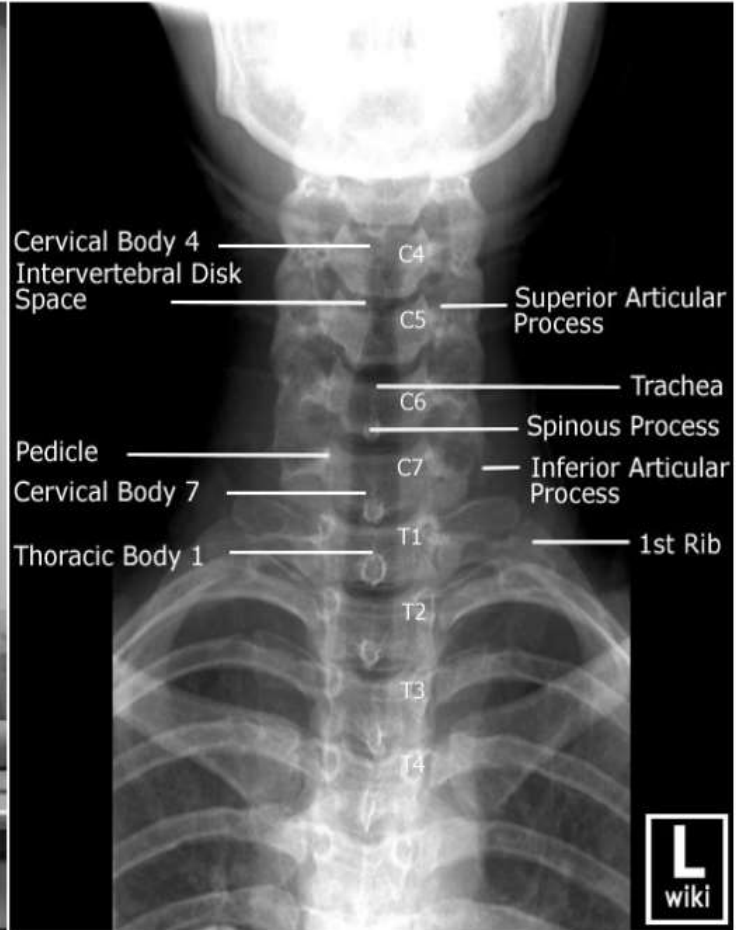
- The cassette is placed behind the neck.
- The upper border of the cassette one inch above the EAM.

Warning

- Do not attend any head or neck movement, if cervical trauma is visible. Female patient care.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
100 cm	Large	Yes	60	48-60	5° to 15° Cephalad	8"X10"



Cervical Spine-Lateral

Patient Preparation

- Ask the patient to remove the all metals plastic retainer & earring also.

Position

- Make the patient to stand in front of the x-ray table in true lateral position.
- Mid saggital plane should be parallel to the center of the table.
- Depressed the shoulder as much as possible.Ask the patient to lowered there shoulder as much as possible so as to avoid overlapping.
- To pull out the patient shoulder more with help of weight bearing(sand bag) on both hands.
- The chin is raised, so that angle of mandible dose not come in way to upper c-spine.
- Ensure there is no rotation of the head.
- Radiation Production given to the patient

Tube Centering

- Center to the angle of mandible or at the level C4 or at the level of the upper border of thyroid cartilage.

Cassette centering

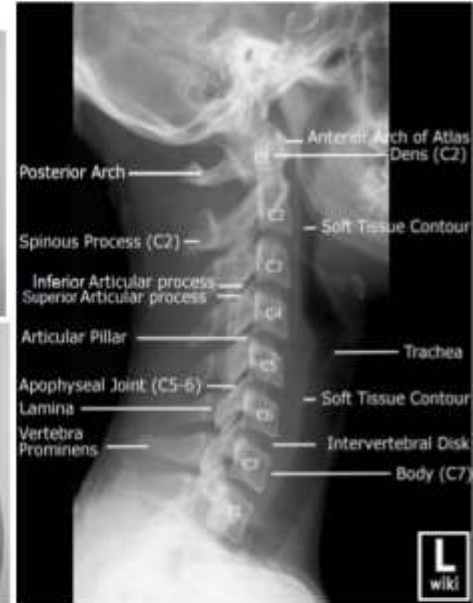
- The upper border of the cassette one inch above the EAM.

Warning

- Do not attend any head or neck movement, if cervical trauma is visible. Female patient care.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
5 Feet	Large	No	55	24-32	No	8"X10"



Thoracic Spine-Anteroposterior

Patient Preperation

- Ask the patient to remove the all metals plastic retainer.

Position

- Make the patient to lie on the x-ray table in supine position.
- Mid saggital plane should be center to the center of the table.
- The patient should face towards the tube.
- Knees are flexed, small pillows are kept between for comfort.
- Large cassette size is used.
- Radiation Production given to the patient.

Tube Centering

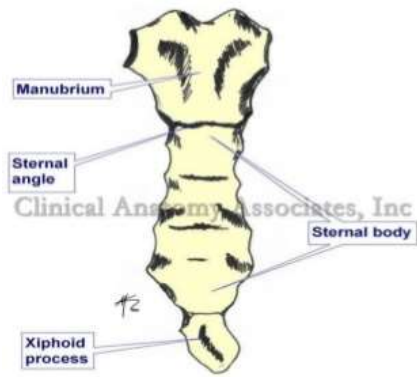
- Direct the central ray at right-angles to the cassette and towards a point 2.5 cm below the sternal angle.
- Collimate tightly to the spine.

Cassette centering

- The upper border of the cassette is kept above spinocoe process of the 7th c-spine vertebra.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
100 cm	Large	Yes	65-70	80-120	0°	12"X15"





Thoracic Spine-Lateral

Patient Preperation

- Ask the patient to remove the all metals plastic retainer.

Position

- Make the patient to lie or stand in front of the x-ray table in lateral position.
- Mid saggital plane should be parallel to the center of the table.
- Arm should be raised well above the head.
- The head can be supported by pillow & pads may be placed between the knee for the patients comfort.
- Radiation Production given to the patient.

Tube Centering

- The tube center at the level of 1" below the axilla T7 & T8.

Cassette centering

- The upper border of the cassette is kept 3 to 4 cm above the spinous process of the C7.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
100 cm	Large	Yes	65-70	100-120	0°	12"X15"

Lumbar Spine

Indications

- Trauma, Fracture, Dislocation, Bone disease, Inflammation, Degeneration, & Kyphosis, skoliosis.

Views

Anteroposterior,
Lateral,
Oblique.



Lumbar Spine-Anteroposterior

Patient Preperation

- Ask the patient to remove the all metals.

Position

- Make the patient to lie on the x-ray table in supine position.
- Mid saggital plane should be center to the center of the table.
- The patient should face towards the tube.
- Both hands are kept by the side of the body.
- Knees are flexed, small pillows are kept between for comfort.
- Large cassette size is used.
- Radiation Production given to the patient.

Tube Centering

- Direct the central ray towards the midline at the level of the lower costal margin (L3).

Cassette centering

- The lower border of the cassette 2 inch below the ASIS.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
100 cm	Large	Yes	65-75	100-120	0°	10"x12" 12"x15"

Lumbar Spine-Lateral

Patient Preperation

- Ask the patient to remove the all metals.

Position

- Make the patient to lie on the x-ray table in lateral position.
- Mid saggital plane should be parallel to the center of the table.
- Hands are fold & kept on the head & knees are flex & small foam pads are kept to avoid movement.
- Small foam pad are kept under the lumbar spine to reduce the lumbar arch & lumbar lordosis.
- Radiation Production given to the patient.

Tube Centering

- Center to the level of lower costal margin at the level of L2 & L3 level.

Cassette centering

- The lower border of the cassette 2 inch below the ASIS.

Exposure Settings

Distance	Focal Spot	Grid	kV	mAs	Tube Angulation	Cassette Size
100 cm	Large	Yes	70-75	120-160	0°	12"x15"

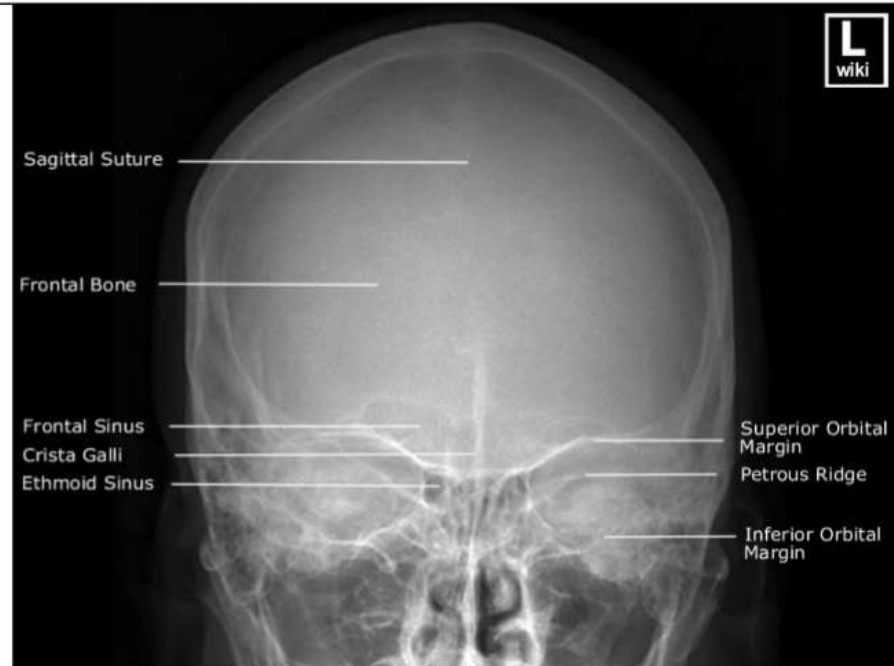
X RAY SKULL



XRAY SKULL

- Easily done erect with the patient seated in a chair or standing.
- Sinus studies should always be done erect to see air fluid levels in the sinuses.

PA view



PA Skull

- ❑ **Measure:** at the Glabella
- ❑ **Protection:** Full coat apron with lead to back or half apron draped over back of chair.
- ❑ **SID:** 40" Bucky
- ❑ **No tube angle**
- ❑ **Film:** 10" x 12" regular I.D. down (portrait)



- Patient seated or standing facing the Bucky.
- *Nose and forehead* touching the Bucky to get the canthomeatal line perpendicular to film.



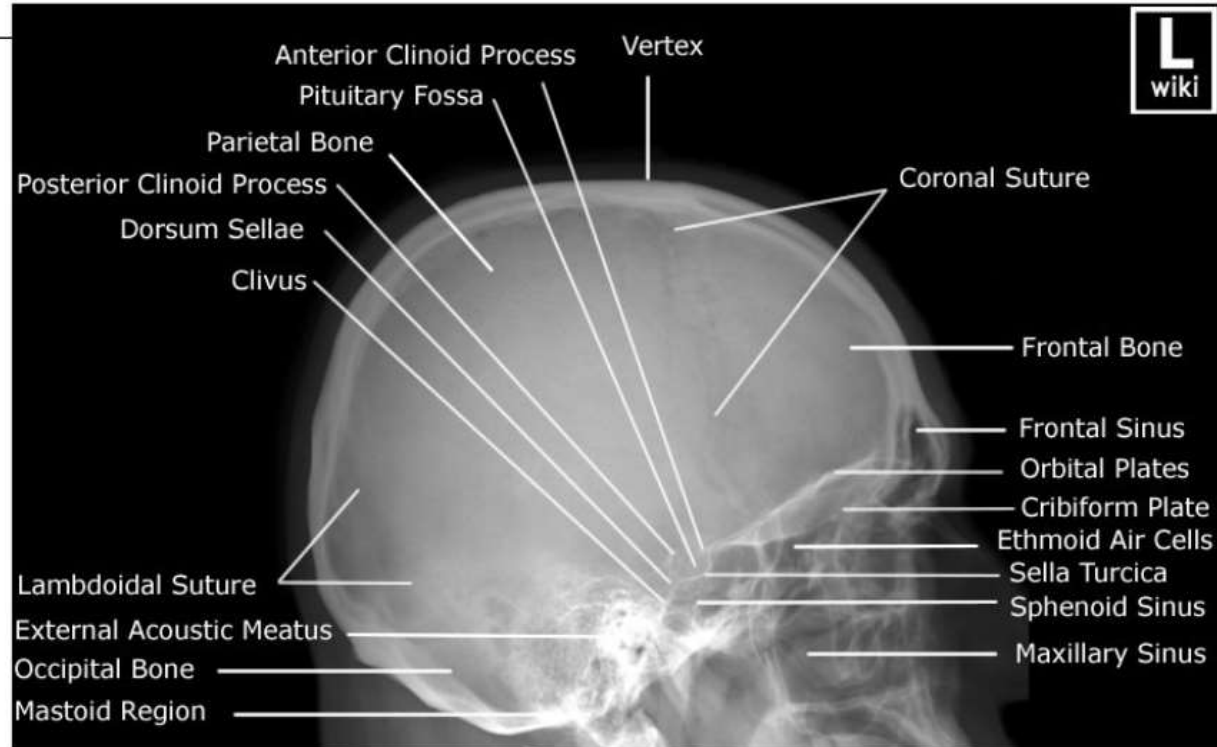
- ❑ **Horizontal CR:** exit through the glabella.
- ❑ **Vertical CR:** mid-sagittal plane
- ❑ **Center film to horizontal CR**
- ❑ **Collimation:** slightly less than film size.
- ❑ **Breathing Instructions:**
Suspended respiration



- ❑ The entire skull should be on the film.
- ❑ There should be no rotation.
- ❑ *The petrous ridges will be superimposed with the orbits.*



Lateral View



Skull Lateral

Patient seated or standing facing the Bucky. Rotate the body into an oblique position.

Turn skull so the **affected** side is next to the Bucky.

The interpupillary line must be perpendicular to film and tube.

Mid sagittal plane parallel to the film.

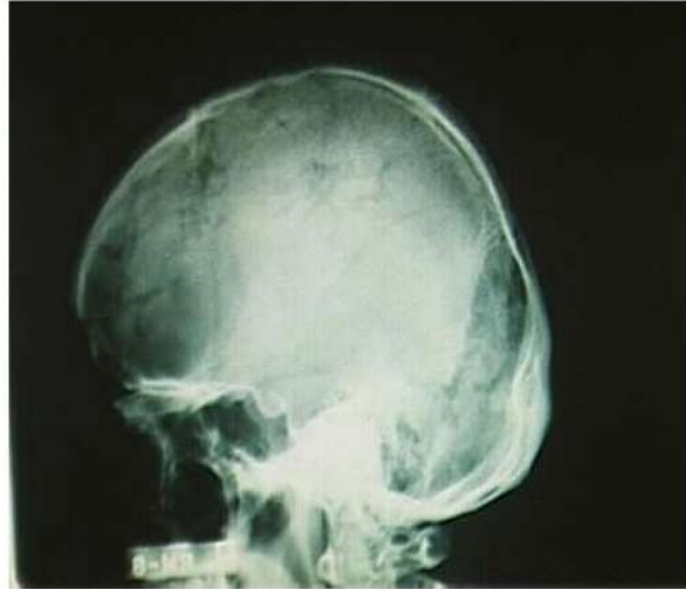


- ❑ **Horizontal CR:**
3/4" superior to EAM
- ❑ **Vertical CR:** 3/4"
anterior to EAM or mid
skull
- ❑ **Center film to
horizontal CR.**
- ❑ **Collimation:** slightly
less than film size
- ❑ **Breathing Instructions:**
Suspended respiration
- ❑ **Make exposure and let
patient relax.**



Skull Lateral Film

- ❑ Entire skull must be on the film.
- ❑ There should be no rotation of the skull, orbits and mandible ramus superimposed.
- ❑ *The facial bones and sinuses will be dark (over exposed).*
- ❑ Usually both lateral views are taken.



Water's view



Waters Projection Sinus

- The most important view for **sinus** problems or *injury* involving the maxilla or orbits.
- By taking the view erect, fluid levels within the maxillary sinuses can be seen.



Waters Projection

- ❑ **Measure:** A-P at Glabella
- ❑ **Protection:** Half apron over back of chair or coat apron backwards
- ❑ **No tube angle**
- ❑ **Film:** 8" x 10" regular I.D. Down (portrait)



Waters Projection Sinus

- Patient is seated **facing** the Bucky. Get the chair as close to the Bucky as possible. May also be taken standing.
- Mentomeatal line should be perpendicular to film with mouth closed.



Waters Projection Sinus

- The nose will be 1-2 cms from Bucky with chin resting on Bucky.
- The mouth may be opened to see the sphenoid sinus. When this is done, the canthomeatal line should be 35 to 40 degrees to the Bucky.





Waters Projection Sinus Film

- ❑ Facial bones and sinuses
- ❑ There should be no rotation.
- ❑ The petrous ridges must be below the floor of the maxilla.





THANK
YOU!